空间句法专栏邀请到伦敦大学学院的劳拉·沃恩教授，她是空间句法实验室的主任，关注与贫穷、社会隔离、健康疾病、经济和社会交易有关的空间模式。她的工作对我国空间句法的研究有很大启发。

杨　滔
《城市设计》副主编
2018年7月20日

The Column of Space Syntax invited Professor Laura Vaughan, the Director of the Space Syntax Laboratory at the Bartlett, UCL. She has led a series of research projects investigating the spatial patterning of poverty, segregation, health and disease, and economic and social exchange. This will essentially inspire the space syntax studies in China.

YANG Tao
Deputy Editor-in-chief of *Urban Design*
July 20, 2018

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本文节选自劳拉·沃恩编著的*Suburban urbanities: Suburbs and the life of the high street*.

参考文献引用格式：
劳拉·沃恩. 商业街的多样性[J]. 城市设计, 2018(4): 6-23.
Vaughan L. High street diversity[J]. Urban Design, 2018(4): 6-23.

收稿日期：2018年7月6日
Received Date: July 6, 2018

商业街的多样性
High Street Diversity

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摘　要
这项关于空间句法的研究从土地利用、街道网络结构和建筑形式等方面对外伦敦城镇中心的多样性进行衡量。通过多层分析发现，从建筑到街道、从街道到邻近街道、从小街道到更广泛的街道网络，它们的内在联系都创造出相互依存的活动。本文认为，如果我们以这种多层次的方式考虑城市中心的多样性，我们就能更准确地理解其城市设计适应性的本质。

Abstract
This space syntax study of a sample outer-London town centres measures diversity in terms of land uses, street network configuration, and built form. The multi-layered analysis finds that inter-relationships, from building to street, from street to neighbouring street and from local streets to the wider network, create an interdependence of activities. This paper concludes that if we consider the diversity of town centres in this multi-layered way, we can achieve a more precise understanding of the nature of their urban design adaptability.

关键词
多样性；用地；建成形态；空间句法；郊区；伦敦

Keywords
Diversity; Land use; Built form; Space syntax; Suburbs; London

1 引　言

现在，为强调繁华商业街多样性的重要性，有关屠夫、面包师和烛台制造商的“童谣”正广为传扬。广义而言，商业街与美国的主街含义大致相同，在讨论有关城镇中心的话题和小城镇中心衰退史时，人们往往会提及商业街。正如格里菲思（Griffiths）[1]在其所述章节中提到的那样，城镇中心的衰败主要体现出两点：一是传统城镇中心包含多种职能，二是此类职能既包含商铺，又包含小型手工艺制造者或制造商。这通常与下述两种情况形成鲜明对比：一种是商业街正逐步转化为由大型连锁店构成的“克隆城镇”，毫无特色可言；另一种则是，商业街正逐渐衰败为二手店和百叶窗商店的接合部。这与网上的零售店形成鲜明对比，则预示着商业街正快速走向“灭亡”。在世界的其他地区，特别是北美地区，虽然凯尔（Keil）和希尔兹（Shields）[2]的研究中有有力证据表明郊区中心未发生“灭亡”现象，但很显然，这一研究与实际状况截然相反；事实上，郊区生活的无限多样性正不断延伸到世界各地。

一些郊区中心衰败的应对方案之一便是发展多样性。政府报告及类似学术研究中曾多次提及发展多样性的重要性，称其为解决郊区中心衰败的有效措施。早期研究中，也曾暗示多功能城镇中心在维持城镇中心与时俱进性过程中的作用：有研究证据表明，不依赖于一种活动形式的城镇中心，具有较强的弹性复原性[3]。但现实情况是，很难实现多样性的精准测量；将空间维度考虑在内的多样性测量方式则更为稀有。毕竟，多样性的空间变异性难以计量。以土地使用情况为例，可在街区范围内、街道两侧、拐角处或某个区域范围内，以混合形式实现多样性。由此，每个区域都会产生相应的社会和经济关系，城镇中心的土地混合使用并不一定是指沿街地块的混合用途。多样性及其对郊区研究意义的测量难点主要在本文所述的研究核心之中。

简·雅各布斯（Jane Jacobs）[4]在其具有影响力的《美国大城市的死与生》*The Death and Life of Great American Cities* 一书中提出创建城市多样性的 4 种状况：各区及各区各部分范围内实现主要职能的多样性；短街区及多交叉路口的多样性；不同风格和年限的楼宇多样性；人口的密集集中，包括所在区的居民人口聚集。雅各布斯的思想观点每隔十年会重复出现一次——这或许是因为这样的观点是对单一功能式分区的有利抨击。对于《美国大城市的死与生》中提及的郊区设置等问题，雅各布斯对人们只是来来往往这一现象的描述显得更为重要，因为这阐明了市民生活的状态：平淡无奇、活动范围较小，这样的生活状态使当地商业中心有了存在的价值。城市是由不同强度的活动和不同职能与人群构成的，近些年，越来越多的作家，如约翰·艾伦（John Allen）[5]，已开始在其作品中展开对城市“有节奏景观”的理解，约翰·艾伦强调光与味的变化规律是如何时复一时地重组城市状况的。帕莱欧勒格（Palaiologou）和沃恩（Vaughan）[6]前几年对曼哈顿连栋排房及伊斯灵顿联排房屋的演化过程研究，为房屋和街道之间的空间界限提供了实验性证据，而街道自身的城市环境反过来也创造了转变模式，即随着人们从房屋移动到当地街道乃至城市的过程中，居民转变为个人、个人转变为通勤人员和居民等，这类转变既有渐进性转变，也有突然性转变。后一项研究表明，职能多样性是如何通过促进当地人和陌生人互相之间的联系，来促进这一转变模式的。职能的多样化创造了一种韵律：当一个人走在街道上时，视觉景观的规律性变化在人们的日常闲逛或漫步过程中构建出一种人与人交织的自然背景。

延续景观语言与考虑灌木篱墙与城镇中心之间的类比关系是一种有趣的事情。根据生态研究，灌木篱墙往往有更具多样化的植物和动物生态，且随着植物和动物的逐年生长，将变得更为茂密、高大且延续性更强[7]。笔者提出，可以类比灌木篱墙的多样性和年龄，设想出“灌木篱墙”式郊区商业街。抛开枝繁叶茂的郊区与葱绿的树篱之间的关联，这一设想昭示着，随着时间的推移，将产生多种独特、复杂、坚固而持久的物质文化。阿兰·佩恩（Alan Penn）及其同事曾指出，多元化区域的形成绝非偶然，而是一种相关系统（社会、经济与文化）及物理系统高结构性布局形成的结果[8]。此外，他们还通过生态理论，阐述了多样性的长期形成结果不是随机的职能、文化和经济混合形成的，而是一种遵循空间逻辑构成的独特模式。正如群体物种的丰富性与均匀性（如同一区域不同类型物种的数量与每个物种的数量）据说可以促进生态系统的整体恢复力这一生态系统理论一样，下述历史形态学的分析与一份历史商业名录的注释探讨了郊区城镇中心多样性与其土地用途和居住历史模式相关联的程度。

在城市形态领域最著名的研究之一中，康泽恩（Conzen）[9]阐明了中世纪阿尼克城镇的土地使用权规划是如何经历连续循环和变迁的，在这一过程中又是如何伴随着地块分段到开敞式平面布置、多种用途、后部院内使用及部分整合等转变的。这不仅仅是一种建成形态或城市肌理功能。遵循这种连续性及变更性模式的基础土地模式有其自有的生命周期，而更重要的是，这种生命周期保持着某种通用的空间关系。已故建筑师理查德·麦克科马克（Richard MacCormac）在其《解剖伦敦》*Anatomy of London*[10]一书中也曾明确提出这一观点：

尽管区域功能不断发生变化，但似乎总有一种关系模式存在，并随着时间的推移，反复出现。例如，在 18 世纪，主要街道的城市大型房屋主要由高收入人群居住着，这类人群的佣工则居住在由马厩改建成的房屋中。在当今社会，这类大型房屋有的成了办公区域，马厩改建的房屋则成了商人提供售卖服务的场所——商业产品或专业服务销售处，如复印店、打印店或三明治吧等。

根据麦克科马克的表述，此类街道“像再居住型珊瑚礁一样”[10]307。建成形态、土地用途及空间构型的相互依存性不可忽视，正如珊瑚礁构成的微妙生态可经受海流、捕食者等的微小变化等（读者不难看出灌木篱墙中出现的类似有效类比性），对这一生态的严重破坏可能会造成致命性后果。对多元化生态在郊区商业街背景下本质的理解，已考虑在本章范围内。

另一个理论方法也得到了解释：将建成环境看作一种构型网络的方式，即采用空间句法分析，测量单个街道与其周围环境的关系，而非孤立地考虑建筑、规划或街道本身。就这点而言，多样性被视为一种空间相关的因素，而非某个区域范围内土地用途（或人群）的随机混合。如上所述，多样性可根据其空间背景，具有不同的形式[11-12]。假设您走在一个街道上，街道两侧设置了 5 种不同的土地用途，对比另一条街道，街道两侧只有一种单一土地用途，但在拐角处有其他 4 种土地用途，如果考虑两者之间的差别，那么将空间细节纳入到“混合用途”中不被考虑的用途设计中则显得尤为重要，而这更适用于通过不同土地用途确立建筑与街道和街道人群之间不同潜在联系的情况。

本文研究了伦敦城市发展的 4 个阶段，为商业街如何适应社会变迁这一新命题提供了事实性依据。[1] 开启了对总体混合土地用途与个别区域空间多样性差别的探讨：多样性的范围甚广，可合力促进商业街丰富生态的形成。对随着时间的推移转变多样性模式的分析，可对应到街道网络的持续性与稳固性。将建筑看作一个物体，即不同人群融合在一起，进行不同的活动，丰富人们日常生活的地方，可解释为维持商业街有价性的一方面，虽无新意但至关重要。本章围绕建立多样性这一主旨结语，阐明了街道形式的持久性是如何与商业街上建筑与规划设计联系到一起的。

2 多样性的概念

多样性的概念与城市和郊区建成环境的现象学属性是密不可分的。这与比尔 • 希利尔（Bill Hillier）等人[13]的论点一致。希利尔等人认为，建成环境的基本可理解性是将公共区域的人们集中在一起，为他们提供相互接触的机会作为一项基本条件。在空间句法理论中，“可理解性”是指某些配置允许人们徒步进行日常活动以及在路旁经过进行长途旅行的能力。佩恩等人[8]的其他研究——建立在希利尔提出的将集中性视为一种时空演变过程[14]这一理论上——提供样例：配有较多土地用途多样性的网格区域有其空间性，可实现更广泛的人流循环，形成更密集、更强化的地区网格[15]。[2] 佩恩等人指出了多样性的另一个基本方面：这不纯粹是土地用途分布的一个方面，他们还认为，为实现土地用途的多样性，城市区域必须“同时支持多元化的社会及经济生活，开放其对声音、视觉及味觉体验的一切外在表现”[8]220。他们建议，实验性多样性通过分化建筑形态、地块和运动模式，形成人类交集的方式形成。此外，现象学家大卫 • 西蒙（David Seamon）强调了“物质空间人体”建成环境经验维度的重要性，西蒙主张城市地区的活跃程度受街道设置、人口密度及活动混合性等物质或空间因素的影响[16]143。城镇中心建筑学—社会形态学的多彩织锦，对比这些区域自然显露，即随着时间的推移，其空间 / 经验特性逐渐凸显重要性（格里菲思[1]在本卷的其他地方已指出），并采用如下方法：驳斥此类站点的明显传统特性，查究有助于塑造其固有复杂性的因素。

3 土地用途多样性

本章描述了以伦敦市外城镇中心为例进行的为期四年的一项研究的部分内容。这建立在之前的一份三年期研究基础之上，这一份三年期研究调查了伦敦郊区的空间和经济发展情况，以寻找到推动其城镇中心和周边区域成功、活性发展的驱动力量。这一研究选取了外伦敦下述 4 个象限的 4 种情况：西北部的海巴尼特（High Barnet）、东北部的劳顿、东南部的南诺伍德和西南部的瑟比顿，将历史和同一时期的土地使用情况、街道网络配置变更及建成形态的详细数据编入到了一个大型地理信息数据库中，以实现对导致中心繁荣的因素做出详细分析。这与两种情况的当代民族志是联系在一起的。

对伦敦历史成长轨迹的首个项目研究发现，随着时间的推移，其郊区街道网络的持续性较高，相对而言，网络发展比较健康。通过瑟比顿自 19 世纪 20 年代以来的演化图可以看出（图 1）：尽管瑟比顿最早时仅是泰晤士河畔金斯顿南部一个较小街道接合部的名称，一直到 1880 年，仍是一个半农村状态的区域，但现在已发展成一个清晰可见的区域。演化图中的序列图像说明了其发展网络的集约化，瑟比顿为重塑其区域网络以适应新的生活方式，发展出了特有的建筑特点（包括车库）；只有在当代地图中才能看出 20 世纪的计划干预，即在金斯顿支路依靠汽车旅游启动活动重点区域的创建，以适应更大的发展需求模式，从而对本区域更大规模的互通性产生深刻影响[17]。

回顾过去，可以看出随着街道网络的演化，路上交通是如何变迁的；反过来，街道网络又是如何根据其最有利的排水距离，通过调整网络布局来满足不同类型的土地使用需求的。空间句法分析将城市网络看作一种空间配置，提出将空间形态、交通模式和土地使用分布之间的根本关系视作一种“移动经济”。经证实，郊区城镇中心及其周围的活动协同效应源于穿

图1 / Figure 1
瑟比顿分别在a.1880年、b.1910年、c.1960年和d.2013年，半径800m分段角度整合覆盖范围内的非住用土地使用情况。参见图4的土地使用情况图例（包含地形测量局数据© 皇家版权/数据库权利2013年）
Non-domestic land uses in Surbiton a. 1880, b. 1910, c. 1960 and d. 2013, overlaid with segment angular integration at 800m. refer to Figure 4 for land use legend (Contains Ordnance Survey data © Crown Copyright/database right 2013)

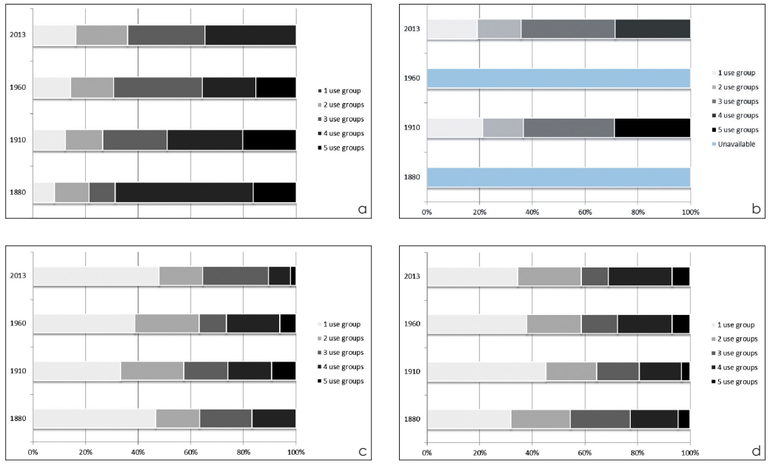


图2 / Figure 2
a.海巴尼特、b.劳顿、c.南诺伍德和d.瑟比顿4个研究区域一直以来土地使用的加权计算
Weighted counts of land uses in the four study areas in a. High Barnet, b. Loughton, c. South Norwood and d. Surbiton across time

越式移动的重叠式移动流（体现在空间句法选择测量与整合之间的统计对应上）。提出不同类型移动方式的重叠，为当地土地用途多样性创造了条件。因此，在图 1 中，1800 年瑟比顿的原始区域布局（图的西北角方向）通过道路与更大规模的网络联系在一起，通往西南部（泰晤士河的边缘）和东南部。到 1890 年，有了铁路网络后，创建了新的联系，以满足不同移动和活动规模的需求。

规模转变的同时，网络的某些部分显现出了路径相依的特点，出现了一些通用特点，因此随着时间的推移，特定轨迹的商业或工业活动最终仍留存至今[18-20]。例如，19 世纪的瑟比顿 Ewell 路提供医生和其他专业性及商业服务[21]3；时至今日，虽然这一路段的餐馆数量较之前大增，但其活动与服务范围与之前则较为相似。

就本文中描述的研究而言，通过记录所有非住用土地用途，创建一个列出所有街道部分的数据集，然后将空间单元归于其附近的建筑物（或相反），使郊区城镇中心的建成环境结构与基础土地用途分布之间的关系与其空间设置相关联。这样，就可以采用不同方式，建立多样性的模型：考虑非住用土地使用在特定街，相对集中，将临街长度或建筑面积以及城镇中心各街道的土地混合使用情况考虑在内——依据土地用途分组（共 5 组）或详细分类（理论上有 26 类，但没有一个研究时段超过 12 类的）。

首项分析主要是在 4 个研究区域各选取一大片区域，研究其纯混合性活动。通过对 1890 年至 2013 年间有持续非住用活动的所有街道划线，确定研究区域，因此那些近年来没有非住用土地使用情况的街道则不在本分析范围内（图 2）。通过加权计算土地使用情况的条形图方式分析了海巴尼特（High Barnet）、南诺伍德和瑟比顿一直以来不同分类的土地用途分布。依图可见，街道分段使用数量增加，后两个时段最多有四五种分类，相应的只有一种用途的街道数量减少。值得注意的是，目前都取得了经济上较大成就（无论是就其生机勃勃的外观主观评估而言，还是依据国家城镇中心统计，其所具备的较大城镇中心面积而言，两个中心都在经济上有较大的成就）的海巴尼特和瑟比顿这两个中心都在其发展过程中，有一定比例的街道混合土地用途情况增加。因此，我们可以得出这样的结论：土地用途的多样性与经济上的成长是相辅相成的。

当将土地混合使用情况的经验维度考虑在内时，多样性用途街道所处的位置也很重要。以瑟比顿为例（图 3），很明显可以看出，从最开始，整个区域内就有非住用土地用途分布，但混合使用情况主要出现在维多利亚路和布莱顿路，这两条道路形成了区域南侧的 V 型结构，而枫叶大道的一小块向东北方向的路段，最早期时主要侧重于一种活动类型，用途混合性较低。

表 1 中，非住用土地用途活动最集中的街道与集中度较低的街道分立存在（非住用土地用途较低的街道可能是由教堂、学校和纯居民区构成）。显然，两组之间有很大的建筑面积差异。在临街长度不断均匀化的同时，较大型建筑物则随之产生，但往往此类建筑物侧重于某些具体用途，如零售等。瑟比顿在所有情况下，一直到 2013 年始终保持着最多变、最持久的活动多样性（图 4），其临街宽度因此也最具一致性，临街宽度的一致性暗示着建筑布局可实现的多样性可能性的数量。

4 移动接口

希利尔等人在一项早期空间句法研究中提出，空间整合数值与选择之间的相互关系很可能会“显示出这两类移动模式之间的相关联程度……居民与陌生人之间的‘移动接口’程度”[13]237。然而，直到近些年，才发展出了验证这一关系的分析方法。选择近似于穿越式移动潜力的措施，整合近似于达到移动潜力的措施，在两种措施的最大值达到最高水平的地方将创造出“不同状态的空间共存和虚拟社区”，正如汉森（Hanson）定义的那样[22]115。可以这么说，整合是一种探索式移动措施，而选择则深受所测量区域的规模（或距离）的影响并且往往会突出主要道路的网络——网络的深度结构。再次，我们将每种情况及 4 个时期产生的峰值相关性考虑在内，更详细地进行了本项分析。

正如之前采用这种形式的分析已经提出的观点一样[22]，最大重叠的地方很可能是那些已经埋设与郊区移动经济相关联的集中性特性的地方。我们将之定义为郊区城镇中心的“空间特征”，这表明一些中心保持着最佳的地方化联系网，而另一些中心既维持着本地化关系网，同时又有更广泛的关系网。当两者紧密相合时，两类活动可在同一旅途上同时发生：都从一个特定起点移动到终点，在途中，做点其他事情，去往不同的道路，这主要取决于所计划（或未计划的）活动是怎样的。在这一网络中，每次去往当地超市时，可以根据个人的周具体计划或移动网格可提供的机会选择，选择不同的路线。有限冗余是指行人活动超出单个街道的情况，并且在正确条件下，发生引发繁荣的交集。

下列分析重点讲述过去 130 年间有持续非住用栖息的街道集合及其直接环境，表 2 说明了相同半径范围内整合与选择的最高相关性（如选择 400m 半径范围与整合 400m 半径范围的相互关系），仅选择比较边界范围内的街道，用粗体突出每个时期的 3 个最高相关性。得出两个清晰结论：第一，注重粗体字的数字（南诺伍德除外），各地区各时期的高低规模分布有一定的一致性（因此，例如，在规定时期内，海巴尼特在半径 3,000m、4,000m 以及 800m 或 1,200m 3 个规模时的相关性最高）。第二，如果我们只侧重于 750 以上（相对较高端）的相关性，则只有海巴尼特和瑟比顿出现了这类情况。可以这么说，这两个中心有一个共同特征：较发达。基于此，较发达是指有

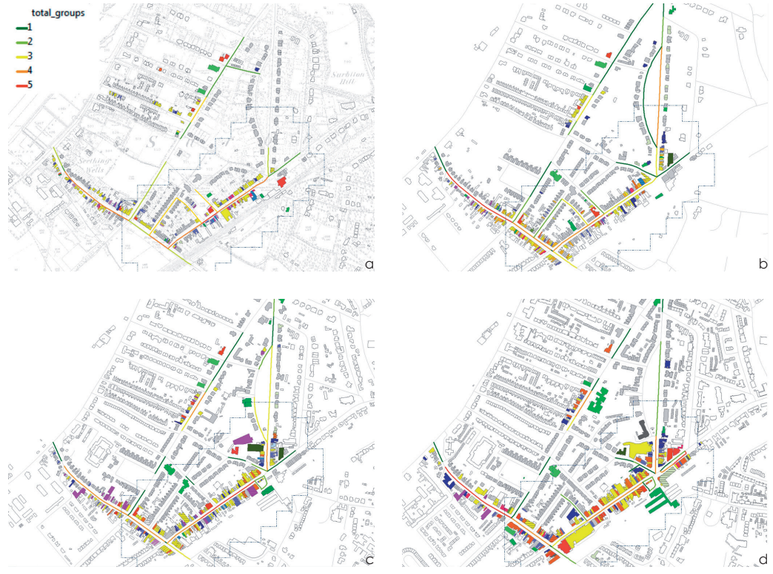
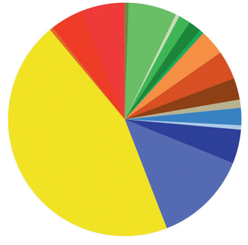


图3 / Figure 3
瑟比顿分别在a.1880年、b.1910年、c.1960年和d.2013年的非住用土地使用情况；图中的道路中间线标色表示每个街道土地使用分组的总数。参见图4的土地使用情况图例
Non-domestic land uses around Surbiton town centre in a.1880, b.1910, c.1960 and d. 2013, with road centrelines coloured to indicate the total number of land use groups in each street section. refer to Figure 4 for land use legend


瑟比顿 (Surbition)1880 年


瑟比顿 (Surbition)1910 年


瑟比顿 (Surbition)1960 年

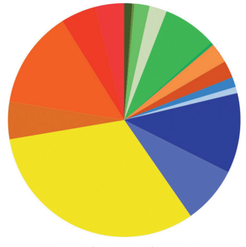

瑟比顿 (Surbition)2013 年

图4 / Figure 4
瑟比顿分别在1880年、1910年、1960年和2013年按照土地使用分类划分的平均建筑面积饼形图
Pie charts showing average building area by use class for Surbiton in 1880, 1910,1960 and 2013

两种规模类型：一种本地，一种较宽范围。两种活动网络重叠。较小一致性是指进行各类旅行活动的人们很少有机会可以相遇，大规模旅行同时发生在本地移动的人们身上；后者较少有机会接触到其直接区域以外的人群。当他们进行较大规模的旅行活动时，则这种交集会发生在非因本目的设计的街道上，如南诺伍德的商业街，在南诺伍德，最典型的一天是，大量的货运车和城市穿梭的公交车可能会将行人淹没，对狭窄的人行道到当地咖啡厅、办公室、中学或商店的环境造成污染（图 5）。接下来，通过将上述值设计成折线图来研究郊区中心嵌入主要道路网络（许多道路网络都是历史形成的）的方式，折线图显示了每个中心历史变迁过程中的重叠程度。4 个历史时期 R2 值的平均值，见图 6。

我们可以看到，南诺伍德只有在400~1600m的低规模区才有高路径的重叠。造成这一结果的唯一原因可能是从车站到目的地采取步行方式最佳，而在高规模区，重叠范围则相对较少。根据铁路线或主要道路网络分割的中心区域似乎对其网格区域有一定的影响，主路周围无形变或集约化现象发生（图 7）。

相比之下，海巴尼特和瑟比顿与向内连接的大路对比而言，网格变形较大。在海巴尼特，繁华中心实际上位于大路上，流通需要穿越繁荣中心区域，或绕道其周围区域，形成集约化形式（正如希利尔提出的更大、更多城市中心功能的观点）[14]。这反映在半径 800 ～ 1,200m 规模范围一致性的强峰上，但最关键的可能是在半径 3,000 ～ 4,000m 的规模范围内。基于这一点而言，瑟比顿的模式略有不同：像南诺伍德以铁路线分割，规模较大时，经受金斯顿旁路来自分流的部分流量；但可能是因为旁路连接到历史道路线的原因，如 Ewell 道路，承担着在其他地区分开路线的重连工作，旁路表现出更大范围的当地连接。像海巴尼特，在 800m、1,600m 和 3,000~4,000m 处有着极强的一致性。

本地差异进一步证实了上述空间特性论题[23]，暂且不考虑本地差异，这些平均值大致可以看作 4 个不同时期的代表值。它们代表着每个地区建成形式 / 移动接口的结构连续性。通过研究两种移动模式之间的关系，可以发现样本区域结构连续性的支持性证据。可论证的是，尽管空间变化较大（例如，考虑到网络面积的先增倍后回缩的情况）[17]，事实上移动接口随着时间的推移始终保持不变，因此便有了结构恢复力这一定义。

尽管穿越式移动仅限于南诺伍德的一条街，像海巴尼特等提供充分本地移动性的区域则存在一定程度的复杂性，海巴尼特等区域不禁止人们因长途旅行而穿梭其中。将交通站设置在城市边缘，而非城市中心，或许有助于缓解人流、交通穿梭产生的压力；同时，也有助于缓解商业街主路上的交通压力。这样就产生了实现集约化发展的替代区域、转向区域，或者城镇中心的发展可以延伸到线性商业街以外的区域。瑟比顿也属于这类情况。瑟比顿有 3 条“商业街”：布莱顿路、维多利亚路和 Ewell 路（虽然枫叶路有其二级职能，但不考虑在内），这 3 条商业街更有效地实现了本地区的繁荣。劳顿在其商业街的两侧都具有一定的本地集约性，但尽管该中心及其周围的人行道数量较多，其成长范围尚未延伸到该区域以外。尽管如此，该中心及其周围大量的非住用活动则是一种标志：虽然其规模不大，但足以经受长时间的发展变迁。南诺伍德则是这 4 种情况中最糟糕的一个。事实证明，尽管南诺伍德最靠近伦敦市中心，其建筑覆盖数量最具城市化，但其集中性特性最不利，无法适应发展变迁所需要的网络结构（或土地用途需求）。

5 楼宇适应性

上述分析说明了，虽然城市原有的实际职能发生了重大变化，但一般类型活动的持续性似乎是多种建筑类型、规模和街道形态综合作用的结果，多种建筑类型、规模和街道形态综合作用，很可能会传播共存的发展模式——为用途稳定性与建筑适应性以及用途类别之间提供最小但必要的平衡。上述引用的麦克科马克提出的“再居住型珊瑚礁”本质上就是建筑规模适应性的写照，但这一现象同时发生在城市规模上。可论证的是，一个城市或中心，不论是在大区域范围内仅允许采取一种土地用途（极端情况）的刻板结构形式，还是采用创建不稳定系统的高转换性商业形式，都不可能发展成功。笔者以上述列出的最成功的街道形态适应性案例之一为例，探索研究区域内几条街道的建成形态和土地适应性。

首先，以瑟比顿 Ewell 路的一段路为例，这段路在过去的 130 年间发生了最高集中性的土地用途变迁（图 8）。很明显，其选址时间是在铁路发展之前。空间句法分析显示，这段路在每个研究时期内，都具有最高“选择”自由度之一，表明其很可能在那段时期受益于高穿越式移动率。其历史发展过程中适应性的另一面是 Ilkka T□rm□ 对可适应性郊区项目执行的建筑调查，其调查结果表明，尽管多数非住用房屋受空间发展的制约——向住宅建筑前后延伸范围较小，或只能在小地块上发展小型建筑——但仍通过多种方式适应了空间发展需求。图 9 的轴侧投影显示了细分部分发展为开敞式平面布置、多用途土地、后院式用途和部分整合的转变模式，整体构成了一种传统的持续性和发展变迁循环[24]。[4] 此类街道的规模具有可恢复性，陶尔马（T□rm□）[25] 的研究表明：较短临街长度、较小建筑占地面积、较小地块面积和较高地块利用率是如何预测用途发展变化的。图 9 表明这段路经历了怎样的分化、整合、拆迁及延展等。与此同时对比活动的高多样性，这段路又保持着土地用途固有模式与发展变迁之间的平衡。这阐明了街道形态的固有状态是如何与建筑物与地块沿街布局联系在一起的。确实，如果我们着重观察图 10 中相同街道在 1907 年和 2015 年的对比图，而不是早期时段行人数量与后期机动车辆数量之间的

表1 / Table 1
非住用临街长度与建筑面积
Non-domestic frontage length and building area

	非住用临街长度（总长，单位：米）Non-domestic frontage length (totals in metres)			非住用建筑面积（每组平均值，单位：平方米）Non-domestic building area(average for each group in turn m²)		
海巴尼特 High Barnet	上游间隔 Upper intervals	下游间隔 Lower intervals	所有非住用区 All non-domestic	上游间隔 Upper intervals	下游间隔 Lower intervals	所有非住用区 All non-domestic
1880	744.17	506.11	1,250.28	949.71	422.82	648.63
1910	819.07	1,351.78	2,170.85	1,178.14	645.69	785.86
1960	1,148.43	1,466.27	2,614.72	1,157.87	1,034.84	1,079.85
2013	830.77	1,227.01	2,057.77	1,499.69	726.90	939.41
劳顿 Loughton	上游间隔 Upper intervals	下游间隔 Lower intervals	所有非住用区 All non-domestic	上游间隔 Upper intervals	下游间隔 Lower intervals	所有非住用区 All non-domestic
1880	Data unavailable	Data unavailable	Data unavailable	Data unavailable	Data unavailable	Data unavailable
1910	311.31	889.65	1,200.95	663.56	552.30	575.48
1960	Data unavailable	Data unavailable	Data unavailable	Data unavailable	Data unavailable	Data unavailable
2013	1,140.83	996.44	2,137.27	2,278.17	750.67	1,181.50
南诺伍德 South Norwood	上游间隔 Upper intervals	下游间隔 Lower intervals	所有非住用区 All non-domestic	上游间隔 Upper intervals	下游间隔 Lower intervals	所有非住用区 All non-domestic
1880	458.03	716.90	1,174.93	789.48	281.23	348.68
1910	1,350.96	1,198.48	2,549.44	1,070.82	455.92	626.73
1960	1,291.11	1,242.76	2,533.87	1,286.56	510.68	716.53
2013	810.60	1,879.90	2,690.50	1,028.13	864.87	902.28
瑟比顿 Surbiton	上游间隔 Upper intervals	下游间隔 Lower intervals	所有非住用区 All non-domestic	上游间隔 Upper intervals	下游间隔 Lower intervals	所有非住用区 All non-domestic
1880	742.48	413.59	1,156.07	1,349.03	389.66	578.58
1910	825.43	597.96	1,423.39	1,452.16	325.36	579.80
1960	803.71	892.68	1,696.39	2,277.45	626.85	968.35
2013	950.75	1,346.98	2,297.73	2,754.92	992.57	1,357.19

表2 / Table 2
相同半径范围内整合与选择之间的最高相关性，仅选择比较边界范围内的街道，用粗体突出每个时期的3个最高相关性
Highest correlation between integration and choice at the same radius, selecting only the streets within the comparative boundary, highlighting the top three correlations for each epoch in bold

海巴尼特 High Barnet	400	800	1200	1600	2000	3000	4000
1880 (n=47)	0.610	**0.817**	**0.831**	0.724	0.741	**0.796**	0.750
1910 (n=57)	0.487	0.695	**0.751**	0.692	0.704	**0.840**	0.820
1960 (n=60)	0.318	0.643	0.616	0.641	**0.700**	**0.808**	**0.813**
2013 (n=68)	0.435	**0.732**	0.727	0.680	0.726	**0.837**	**0.846**
劳顿 Loughton	400	800	1200	1600	2000	3000	4000
1880 (n=27)	0.434	0.436	0.577	**0.706**	**0.746**	**0.664**	0.686
1910 (n=36)	0.568	0.494	0.574	**0.681**	**0.748**	**0.683**	0.653
1960 (n=52)	0.548	0.709	0.639	**0.727**	**0.751**	**0.548**	0.482
2013 (n=69)	0.646	**0.716**	0.565	0.581	0.644	**0.715**	**0.705**
南诺伍德 South Norwood	400	800	1200	1600	2000	3000	4000
1880 (n=58):	**0.695**	**0.651**	**0.631**	0.607	0.563	0.588	0.612
1910 (n=90):	0.627	**0.698**	**0.665**	**0.660**	0.622	0.535	0.609
1960 (n=94):	0.642	**0.727**	**0.723**	**0.697**	0.669	0.633	0.661
2013 (n=107):	0.639	**0.742**	**0.717**	**0.708**	0.696	0.633	0.600
瑟比顿 Surbiton	400	800	1200	1600	2000	3000	4000
1880 (n=41):	0.386	0.761	0.668	**0.814**	0.736	**0.778**	**0.763**
1910 (n=48):	0.567	**0.776**	0.702	**0.858**	**0.813**	0.740	0.790
1960 (n=61):	0.417	**0.774**	0.653	0.750	0.728	**0.815**	**0.787**
2013 (n=76):	0.674	**0.892**	**0.862**	**0.777**	0.745	0.761	**0.777**

差别，就会发现道路周边仍保留其原有状态才是该路段最显著的特征。

6 结　论

生物类推在建筑领域繁衍，很大程度上是因为建筑空间的有序性。然而，在这种情况下，通过对历史城镇中心本质的现实观察，可以得出商业街的概念：城镇中心看起来有更丰富、更多元化的混合用途；并且这种多样性一方面遵循空间逻辑，另一方面与这些地方的社会与经济活力密不可分。与城市系统的这一生态类比有效重述了多元化生态系统具有可恢复性且能更好地适应社会变迁这一命题，详细信息参见早前有关本专题的一份会议文件 [26]。

比尔·希利尔曾提出，中心的形成通常是从空间萌芽，如交叉路口或单个的道路分段开始的，交叉路口或单个的道路分段将借助其空间配置，具备塑造其未来成长的特定空间特性 [27]42。本研究已为希利尔的论点提供了支持性证据，其论点是中心的后续成长依赖于本地街道联系与更大范围（“全球”范围）街道联系之间的相对平衡，穿越中心的街道形成了邻里之间及更远中心之间的相互联系程度。证据显示，所研究的这 4 种情况以其过去 130 年的演化发展过程，更成功地证实了希利尔的理论。

本文给出的研究表明：邻街长度变窄、建筑占地面积变少、地块规模变小及地块利用率变高，都预测着土地使用情况的变化，但这并不充分说明，自身土地使用情况的变化是一种弹性措施，或建筑物对发展变迁的适应性。尽管此类街道或街道分段区属于活跃区域——正如我们 20 种研究案例中多数情况一样——它们都有连续性非住用活动，但从相同土地用途在发展变迁过程中仍持续存在这一点而言，无法充分说明这类区域的土地用途具备弹性特征。相反，它们都属于土地用途可反复更替的区域。可观察到一个缺点，有些地块为建立较大型建筑物，已呈现合并发展趋势，这意味着从长期来看，土地用途的多样性范围较之前将缩减。解释这一过程的一种推测是，这种空间限制不允许变迁需求的发生。空间受限建筑物的土地用途变更发生率最高，最明显的变更发生在高效拼合地块的非住用建筑物上。本分析还说明，位于较大地块的小型建筑物更容易遭受不可逆转的变迁。总体而言，土地用途变化的总预测器是街道本身的可达性以及街道区域适应其本身和周围移动变更尺度的灵活性。

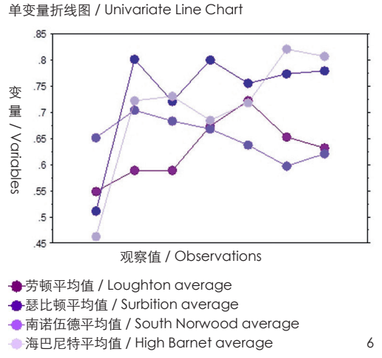
此外，本研究还表明：与城市中心相比，规模较小的城镇中心在城市范围内的联系网络较小，因此其抗风险能力较弱，但中心街道网络的复杂性有助于增强城镇中心应对经济低迷或社会变迁（如不同种群的人口迁移）等外部破坏性力量的可恢复性。在我们的研究案例中，这点可以通过少数干线道路及其沿线良好的公共交通状况（地上铁路与公交线路）的相互联系性体现出来。与城市中心相比，城镇中心的人口密度较低，这意味着郊区城镇中心面临经济低迷时，在某种程度上需要付出更大的努力才能维持自身状况。同时，城市从中心到外缘的长期成长过程会导致本地移动环境原有路径与区域内交通扩展之间的冲突 [28-29]。其研究认为，形态多样性带来了小规模中心缝隙市场的发展，缝隙市场可支持新形式的社会经济活动。

多样性的概念与城市和郊区建成环境的社会属性是密不可分的。正如建成环境的根本可理解性是将公共区域的人们联系在一起并产生交集的必备条件一样，多样性在郊区城镇中心相对稀疏的环境中，扮演着与之同等重要，或更重要的作用。大小规模的建筑物混合可实现城镇中心范围内多种规模商业活动的混合以及相互依存性活动阵列的形成。这就是本研究将较大范围（一公里范围内的集中土地使用情况和三公里半径范围内建成形式和网络互通性）下的商业街考虑在内的原因。通过将更大范围的空间生态考虑在内，我们实现了对土地使用情况与其受服务群体及使用人群之间充分相关性的探索。

显然，多样性不等同于“混合用途”。建筑物与街道、街道与临近街道以及本地街道与外部网络之间互动关系模式的空间结构，创造出的活动的相互依赖性，比麦克科马克所观察到的相互依赖性范围更广。如果我们认为，本文对多样性的讨论主要侧重于土地使用情况的多样性，那么这一发现则具有更大的意义。我们或许可以合理建议并将多样性用作共存的代用词。人们往往很容易忽略土地使用多样性这一不证自明的方面：土地使用情况越多样，越可能会有不同类型的人群从事不同类型的活动。

如果我们暂且考虑社会多样性，那么可以联想到巴黎的民间风俗：巴黎城市院落呈纵向分层模式，主楼层居住着资产阶级，阁楼区域居住着下层人民 [30]。[5] 柏林呈横向分布，富人居住在前区，穷人居住在后区；伦敦则呈分路段分布之势，线性集中，边缘分开，在布斯绘制的穷人分布图中可以看出，分布图中显示不同的街道阵营分布着不同的穷人等级 [31]166。正如研究显示，这些街道的混合使用情况都是规律性存在的，互不干涉。以伦敦为例，街道阵营，而非街区，已成了伦敦的基本组织城市元素。不同用途或使用级别并列存在，但按照允许不同网格存在的情况分别存在于不同街道，不同网格发挥着在主街道（可布置更多的公共需求活动）上产生大移动量，在后街道区域产生小移动量的作用。此类空间模式的形成过程，甚至在城市郊区，显然都是伦敦城镇中心持续性与稳固性的关键，在本文已得到验证。[6]

5



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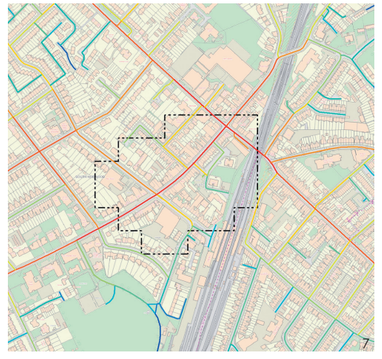
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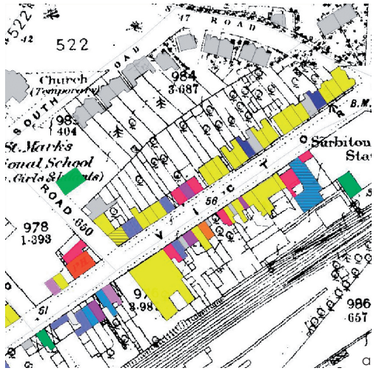
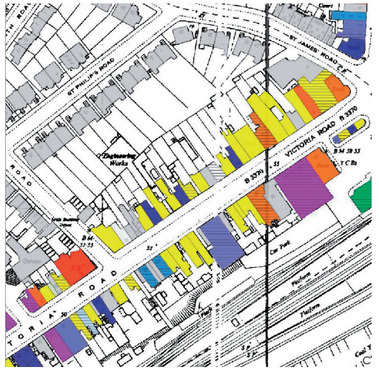


a

b



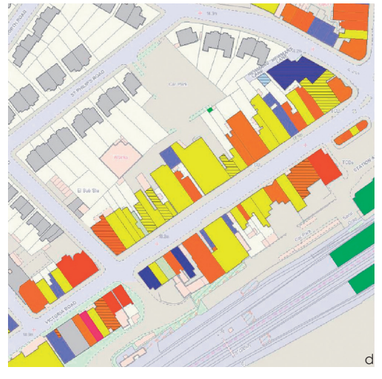

d

图5 / Figure 5
南诺伍德商业街的交通状况2008
Traffic on South Norwood high street 2008

图6 / Figure 6
400m、800m、1,200m、1,600m、2,000m、3,000m和4,000m半径范围内重叠区域的折线图（从左到右）
Line chart showing overlap between radius 400m, 800m, 1,200m, 1,600m, 2,000m, 3,000m and 4,000m (from left to right)

图7 / Figure 7
与半径800m范围内分段角度整合重叠的城镇中心（采用黑色破折号标注出峰值活动区域）周围南诺伍德街道的现代布局图
Contemporary map of South Norwood street layout surrounding the town centre (with peak activity area marked in black dashes) overlaid with segment angular integration 800m

图8 / Figure 8
瑟比顿维多利亚路分别在（a）1880年、（b）1910年、（c）1960年和（d）2013年的非住用土地使用情况。参见图4的土地使用情况图例
Non-domestic land uses, Victoria road, Surbiton in (a) 1880, (b) 1910, (c) 1960 and (d) 2013. refer to Figure 4 for land use legend

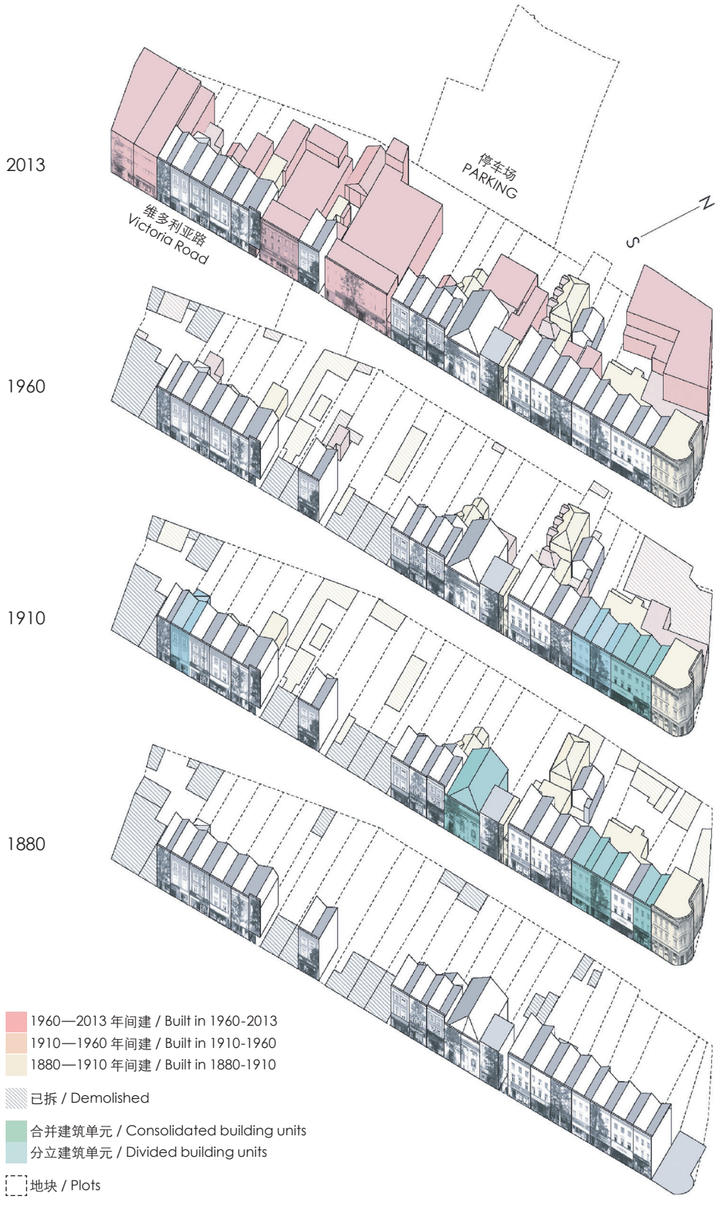


图9 / Figure 9
瑟比顿维多利亚路北侧建成形态发展变迁的侧轴投射
Axonometric projection of the built form changes over time on the north side of Victoria road, Surbiton
来源 / Source: © Ilkka Törmä

图10 / Figure 10
a. 1907年瑟比顿维多利亚路; b. 2014年瑟比顿维多利亚路
a. Victoria Road, Surbiton, 1907 From the private collection of Dr Ruth Davies; b. Victoria Road, Surbiton, 2014 © Ilkka Törmä
来源 / Source: a. Dr Ruth Davies的个人资料收集; b. © Ilkka Törmä

FULL TEXTS TRANSLATED FROM ENGLISH

High Street Diversity

Laura Vaughan

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Source: Provided by Laura Vaughan

1 Introduction

The nursery rhyme of the butcher, the baker and the candlestick-maker is increasingly used nowadays to emphasise the importance of diversity in the high street. Broadly equivalent to the main street in the USA, the high street is a common metonym used in public debate when discussing town centres and is frequently alluded to when discussing the apparent decline of smaller centres. As shown by Griffiths in his chapter for this volume[1], discussions of town centre decline typically manage to convey two messages at once: that the traditional town centre contains a variety of uses, and that those uses will include both shops and small-scale craftsmen or manufacturers. This is frequently set in contrast to cases where high streets are transforming into bland "clone towns" comprised of large chains or where high streets are in decline, comprised of charity shops and shuttered business units. Or, alternatively, it is presented in contrast to the supposed move of retail online, with the "death" of the high street approaching fast. Elsewhere in the world, particularly in North America, the death of suburbia's centres has apparently already occurred, despite strong evidence to the contrary from research conducted by, e.g., Keil and Shields [2], and indeed the infinite variety of suburban life continues to spread world wide.

One solution to the decline of some suburban centres is diversity. It is a measure of success increasingly cited in government reports and academic research alike, and earlier research has suggested how multifunctional town centres sustain adaptability over time: with evidence that centres are much more resilient if they are not reliant on just one form of activity [3]. But the reality is that diversity is rarely measured with any great accuracy or detail and measures of diversity that take account of a spatial dimension are rarer still. After all, diversity has innumerable spatial variations. If we take land uses as an example, diversity can take the form of mixing at the scale of a block face, two sides of a street, around a corner or within a certain distance. Each of these has consequential social and economic relationships, so a mix of uses across a town centre does not necessarily mean that uses are mixed along a street alignment. The challenges of measuring diversity and its significance for suburban studies lie at the heart of the research described here.

In her influential book *The Death and Life of Great American Cities*, Jane Jacobs [4] proposed four conditions for creating city diversity: a mixture of primary uses within each district and within each part of the district; short blocks and multiple intersections; a variety of buildings of different types and ages; and a dense concentration of people, including people resident in the district. Her ideas recur in every decade since—probably as they are such a powerful argument against monofunctional districts. For suburban settings such as those described in this book, Jacobs' description of the daily ballet of people as doing little more than coming and going is even more important, as it demonstrates how public life is comprised of the prosaic, small-scale activities that collectively make a trip into the local centre worthwhile. An understanding of the "rhythmic landscape" of cities, comprised of differing intensities of activity, and different uses and people, has been taken up by more recent writers, including John Allen [5], who emphasises how even changing patterns of light and smells recompose the city hour by hour. More recent research by Palaiologou and Vaughan [6] on the evolution of Manhattan's row houses and Islington's terraced houses provides empirical evidence on how spatial boundaries between house and street and the street's own urban setting in turn, create shifting patterns where the individual is (successively or abruptly) transformed from inhabitant, to commuter and to citizen as they move from house, to local street, and to the city at large. The latter research shows how diversity of uses contributes to this shifting pattern, by bringing local and stranger into contact with one another. The diversity of uses creates a rhythm, where, as one walks down a street, a regular change in the visual landscape creates a natural setting for an intermingling of people on their daily perambulations.

It is interesting to continue the language of landscape and to consider an analogy between hedgerows and town centres. Ecological research proposes that hedgerows tend to have a much greater diversity of plants and animals and to be thicker, taller and more continuous as they increase in age [7]. This chapter proposes that there is an analogous consideration of diversity and age that can be made by conceiving suburban high streets as "hedgerows". Beyond the rather neat association between leafy suburbs and green hedges, such a conception implies the emergence of distinctive, complex and stubbornly persistent material cultures over time. As Alan Penn and colleagues have pointed out, diverse areas are not formed randomly, but are the outcome of highly structured sets of related systems (social, economic and cultural) as well as physical [8]. Also referring to ecological theory, they state how the outcome of the long-term formation of diversity is not a random mixing of uses, cultures and economies, but a distinct pattern that follows a spatial logic. Just as in ecological systems theory, where the richness and evenness of species in a community (i.e., the number of different types of species and the number of each species in the same area) are said to contribute to the overall resilience of the ecosystem, the following historical morphological analysis, together with an exegesis of historical business directories, explores the extent to which the diversity of suburban town centres is associated with their historical pattern of land use and habitation.

In one of the most famous studies in the field of urban morphology, Conzen [9] showed how the mediaeval burgage plots of the town of Alnwick went through a cycle of continuity and change over time, with shifting patterns of plot sub-division into open-plan, multiple use, rear courtyard uses and partial consolidation. This is not a mere function of built form or urban tissue. The underlying land pattern that follows this pattern of continuity and change has its own life cycle, but importantly, this lifecycle maintains certain generic spatial relationships. As was proposed so lucidly by the late architect Richard MacCormac in his Anatomy of London [10]:

there seems to be a pattern in the relationships

which reoccurs over time though the functions change. For example, in the eighteenth-century city large houses on primary streets were inhabited by high income families and the mews behind serviced them. Today the houses might be offices with the mews inhabited by businesses selling services—commercial or professional—like photocopying, printing or sandwich bars to the primary users.

According to MacCormac, such streets are "like reinhabited coral reefs" [10]307. This built form, land use and spatial configurational interdependence are not trivial matters, since just as much as coral reefs constitute delicate ecologies that can weather minor changes in sea currents, predators and the like (and the reader can easily discern a similarly effective analogy to be made with regard to hedgerows), a major disruption to that ecology can be life-threatening. Understanding the nature of diverse ecology in the context of the suburban high street is considered in this chapter.

Another theoretical approach needs explaining at this juncture: the way in which the built environment is considered as a configurational network, one in which, rather than considering buildings, plots or streets in isolation, the relationship of a single street to its surroundings is measured using space syntax analysis. In this way, diversity is considered as a spatially related factor, rather than a random mixing of land uses (or people) within an area. As mentioned above, diversity can take different forms according to its spatial context [11-12]. If one considers the differences in experience between, say, walking down a street with five different uses on both sides of the street, to that of a street where only a single use is observed on either side, but four others can be found round the corner, the importance of bringing the spatial detail into what would otherwise be dismissed as "mixed-use" becomes evident. This is even more the case when one considers the way in which different uses set up different potential connections between building and street and the people using that street.

This chapter examines four periods of London's development to provide evidence for a new proposition on how high streets adapt to change.[1]

It opens with a discussion of the need to distinguish between mixed-use in general and spatial diversity in particular: the fact that diversity has many dimensions that arguably work together to make for a rich ecology of the high street experience. Analysis of shifting diversity patterns over time is shown to correspond to the continuity and robustness of the street network. Seeing architecture as an object—where the mixing of different people carrying out different activities makes for the rich experience of encounter and daily routine—is shown to be a mundane but vital aspect of what makes high streets places that continue to be valued. A focus on building diversity ends the chapter, illustrating how the persistence of street form is tied up with how buildings and plots are arrayed along the high street.

2 Concepts of Diversity

Notions of diversity cannot be separated from the phenomenological properties of urban and suburban built environments. These are consistent with claims made by Hillier et al.[13] that the fundamental intelligibility of the built environment is an essential condition of bringing people together in public space and affording them encounter. In space syntax theory "intelligibility" refers to the ability of certain configurations to allow for an overlap between people carrying out local activities on foot, alongside people passing through on their way to longer distance trips. Other research by Penn et al. [8]—building on Hillier's proposition regarding centrality being part of a spatial-temporal process [14]—has shown for example that areas of the grid with a greater amount of land use diversity have spatial properties that allow for greater amounts of circulation, with a denser and more intensified local grid [15].[2] Penn et al. point to another essential aspect of diversity: this is not purely an aspect of land use distribution, and in order to have land use diversity, they argue, an urban area must "support a diverse social and economic life as well, with all the outward manifestations of that which are open to the sensory experiences of sound, sight and smell" [8]220. They suggest that experiential diversity is formed by differentiating building shapes, land parcels and movement patterns, and consequently shaping the pattern of human encounters. The importance of the experiential dimension of the built environment, of "human bodies in material space", has also been highlighted by the phenomenologist David Seamon, who maintains that the vibrancy of urban places is supported or stymied by the material or spatial qualities such as street configuration, population density and mix of activities [16]143. This rich tapestry of the architectural—social morphology of town centres, alongside the importance of seeing such places as emergent—that is, as having developed their spatial/experiential qualities over time (as pointed out by Griffiths elsewhere in this volume)[1]—is the approach used here: intending to refute the apparently conventional nature of these sites and enquire into the forces that help shape their inherent complexity.

3 Land Use Diversity

This chapter describes research that took place as part of a four-year study of a sample of London's outer town centres. This built on a previous three-year study, which looked into the development of London's suburbs both spatially and economically to find the factors that make their town centres and surroundings successful and vibrant. The four cases were chosen from each of the outer London quadrants: northwest (High Barnet), northeast (Loughton), southeast (South Norwood) and southwest (Surbiton), and detailed data on historic and contemporary land uses, changes in street network configuration and built form were compiled into a large geographical information database to allow for detailed analysis of the factors that contributed to the centres' success. This was coupled with a contemporary ethnography of two of the cases.

The first project's research into London's historical growth found that its suburbs had a high degree of continuity in street networks over time, providing a relatively robust network. This can be seen on the sequence of maps of Surbiton's evolution since the 1820s (Figure 1). Whilst in the earliest period Surbiton was the name for the small junction of streets south of Kingston upon Thames, by 1880, though still a semirural area, it had loci of settlement that are recognisable today. The sequence of images shows intensification of the network, with particular building features (including garages) reshaping the network to accommodate new ways of living; it is only in the contemporary map that the planned interventions in the twentieth century are seen to have had a profound effect on the larger scale connectivity of the area when the Kingston ByPass enabled the creation of a focus of activities reliant on car travel and corresponding to wider patterns of accessibility, but not local ones at all, such as a traveller's hotel (see more on this in the chapter by Dhanani in this volume) [17].

If we peel back to the past we can see how the availability of passing movement changes with the evolution of the street network; it in turn adapts its configuration to serve land uses of different types, according to the most beneficial catchment distances. Space syntax analysis considers the urban network as a spatial configuration, proposing a fundamental relationship between spatial morphology, movement patterns and the distribution of land uses as a "movement economy". The synergy of activities in and around suburban town centres has been shown to stem from the presence of over lapping movement flows of through movement (represented by a statistical correspondence between the space syntax measures of choice and integration). This overlapping of different types of movement is proposed to create the conditions for local diversity in land use. So in Figure 1 we see that in 1800 the original settlement of Surbiton (on the northwestern edge of the map) was connected to the larger scale network through roads leading to the southwest (on the edge of the river Thames) and to the southeast. By the time the railway arrived in 1890, new connections had been created to serve a different set of scales of movement and activity.

In parallel to this shifting of scales, some sections of the network show features of a path dependency, with certain generic characteristics emerging, so that a particular trajectory of a business or industrial activity ends up persisting over time [18-20]. For example, Ewell road in Surbiton served doctors and other such professional and commercial services in nineteenth century Surbiton [21]3 and today it serves a very similar range of activities and services, although with more restaurants than in the past.

In the case of the research described here, the relationship between the structure of the built environment and functional land use distribution in suburban town centres was associated with its spatial setting by recording all non-domestic land use and constructing a dataset in which all the street sections were listed, and then attributing the spatial unit to the buildings lying alongside it (or vice versa). Diversity was then modelled in differing ways: considering the relative concentration of non-domestic uses in particular streets, taking account of frontage length or building footprint area as well as the degree of land use mix street by street across the town centre – either according to land use group (of which there are five) or by the finer detailed class (of which there are theoretically twentysix, although none of the cases had more than twelve in any of the studied periods).

The first analysis looks at the pure mixing of activities across a large area of each of the four cases. The areas were determined by drawing a notional line around all the streets which had continuous non-domestic activity from 1890 to 2013, so there might have been streets excluded from the analysis if their non-domestic uses did not exist in more recent periods. The distribution of the different classes of use over time was analysed by drawing bar charts of weighted counts of land uses in High Barnet, South Norwood and Surbiton (Figure 2). These graphs show an increase in the proportion of street segments with the maximum of four or five use classes in the latter two periods and a commensurate decrease in streets with only one use. Notably, both High Barnet and Surbiton—the two centres with greater economic success today (not only by the subjective assessment of their more vibrant appearance, but also in their possessing a larger town centre area according to national town centre statistics)—also have an increase in the proportion of streets with a mixing of uses over time. We might conclude from this that diversity of use goes hand in hand with economic success over time.

The location of these streets with diverse uses is also important when taking account of the experiential dimension of land use mix. Take Surbiton for example (Figure 3), it is clear that non-domestic land uses are spread out through the area right from the earliest period, but mixing of uses occurs principally on Victoria road and Brighton road, the two streets which form a V to the south of the images, whilst a small section of Maple road, running northeast, has a focus of activity through the period, but with a lower level of mixing.

In Table 1 the streets with the greatest concentration of non-domestic land use activity are separated from those with fewer such uses (so these might be streets with a church and a school, with the remaining buildings being purely residential). Evidently there is a big difference in building area between the two groups. Whilst frontage length becomes more even over time, we see the emergence of larger buildings overall, but also a focus on certain uses, such as retail. Surbiton, which of all the cases has the most varied and constant diversity of activity all the way through to 2013 (Figure 4), also has the most consistency in the width of frontages, an indication of the amount of potential for diversity available in the building alignment. These differences are picked up in the penultimate section.

4 Movement Interfaces

Hillier et al. suggested in an early space syntax study that it is likely that a correlation between the mathematical values of spatial integration and choice might "index the degree of correlation between these two types of movement pattern ... the degree of "movement interface" between inhabitants and strangers" [13]237. However, it is only in recent years that the analytic capability has been developed to examine this relationship. Whilst choice approximates a measure of through movement potential and integration approximates a measure of to movement potential, the locations where the highest values for both measures overlap to the greatest degree will create, as termed by Hanson, "different modes of spatial co-presence and virtual community" [22]115. It could be said that integration is a measure of exploratory movement, whilst choice is highly influenced by the scale (or distance) at which you are measuring and it will tend to highlight major road networks—the deep structure of the network. Here we repeat this analysis in greater detail by considering where peak correlations exist for each case and across the four periods. This analysis of co-presence is carried out through time to ascertain the changing peak locations of co-presence in the network.

As has been proposed in an earlier piece using this form of analysis [23], the location of greatest overlap is likely to be where the qualities of centrality associated with suburban movement economies are most likely to be seeded. We termed this the "spatial signature" of suburban town centres, suggesting that some centres operated best for a much more localised network of connections, whilst others sustained connections both locally and more widely. Where the two correspond closely, two sorts of activities can easily coincide during the same trip: both moving from a particular origin to destination and en route doing other things,

going different ways, depending on whatever combination of planned (and unplanned) activities is desired. In such a network, the same trip to the local supermarket can take a different route each time, depending on an individual's specific plans that week or indeed what the grid offers up opportunistically. A limited amount of redundancy means that pedestrian activity spreads out beyond a single street and, given the right conditions, enables interactions to flourish accordingly.

Bearing in mind that the following analysis focuses on the set of streets and their immediate environs that had continuous non-domestic inhabitation over the past 130 years, Table 2 shows the highest correlation between integration and choice at the same radius (e.g. choice 400 correlated with integration 400), selecting only the streets within the comparative boundary, highlighting the top three correlations for each epoch in bold. Two clear findings emerge: first, focusing on the figures in bold, with the exception of South Norwood, the cases have a distribution of high as well as low scales within which there is a correspondence throughout the periods (so for example, High Barnet has its top three correlations at scales of 3000 and 4000 as well as 800 or 1200 in any given period). If we then focus only on correlations above .750, which are at the higher end, only High Barnet and Surbiton have any such cases. It might be said that this is a feature of these two centres, which are the more successful. The meaning of this on the ground is that there are two scales—one local and one wider-reaching—at which the two networks of activity overlap. Less correspondence means that there are fewer opportunities for people carrying out varying journeys to intermingle—large-scale trips occur in parallel to people moving locally and the latter have less opportunity to explore beyond their immediate neighbourhood. Where they do intermingle with wider-scale trips, this occurs in streets that were not intended for this purpose, such as in the high street, South Norwood, where on a typical day pedestrians can be overwhelmed by the volume of heavy goods vehicles and buses making trips across the city, polluting the atmosphere for people walking down the narrow pavements to the local café, office, high school or shops (Figure 5). In the following, the way in which the suburban centres are embedded in major road networks (many of which are historical) is studied by plotting the above values in line charts which show the shift in degree of overlap over time for each centre. Figure 6 shows the result of averaging the r2 value across the four periods.

We see that South Norwood has high path overlap only at the lower scales of 400~1,600m—which may only be due to the effective walking distance from the station—with much less overlap at the larger scales. The segmentation of the centre by the railway line as well as by the major road network seems to have an effect on its grid, with no deformation or intensification around the main roads (Figure 7).

In contrast, High Barnet and Surbiton have a much greater grid deformation alongside large roads connecting onwards. In Barnet the live centre is actually on the big road and the circulation is across it, as well as circuitously around it in a form of centrality (as proposed in fact by Hillier as a function of larger, more urban centres [14]). This is reflected in a strong peak of correspondence scales at the 800m~1,200m range, but then again at what may be critical: the 3,000m~4,000m scales. Surbiton has a slightly different pattern on the ground: like South Norwood, it is segmented by the railway line and, at a very large scale, suffers to a certain degree from the Kingston By-Pass; yet possibly because the bypass links back to historic road alignments, such as Ewell road, it serves to reconnect what it divides elsewhere—it projects local connections at a higher scale. Like High Barnet it has a strong correspondence at 800 and also at 1600 and then exactly the same at 3000m~4000m.

Putting aside the local differences, which add further veracity to the spatial signature argument mentioned above [23], these averages are fair representations of all the different periods. They represent the structural continuity of the built form/movement interfaces in each of these places. By looking at the relationship between the two types of movement pattern, there is supporting evidence for structural continuity across the sample. Arguably this is a definition of structural resilience in terms of the way in which, despite the massive spatial change (consider the doubling and then half again in size of the network, for example—see also Dhanani's chapter in this volume) [17], the fact is that the movement interface index remains consistent over time.

Whilst through movement is restricted to only the one street in South Norwood, there is a degree of complexity in places such as High Barnet that provides enough local movement, without preventing people from making larger trips across and through it. Having the station situated on the edge rather than cutting through the centre perhaps helps in this instance; what also possibly helps is the fact that the main road runs through the high street without overwhelming it with heavy traffic. There are alternatives, turnings off, that allow for centrality to develop, or at least, the town centre can spread beyond the linear high street. Surbiton is another such case with its three "high streets"—Brighton road, Victoria road and Ewell road, (notwithstanding Maple road with its secondary functions)—that allow the town centre to spill over and around the corner in a much more effective way. Loughton has some local centrality either side of its very strong spine of a high street, but despite a large number of pedestrian routes in and around it, it has not extended its growth that far beyond it. Nevertheless, the relatively large amount of non-domestic activity in and around its centre is a sign that, despite its relatively small size, it has sufficient adaptability to weather long-term change. South Norwood is effectively the worst-off of all four cases. It has not managed to adapt its network (or its uses) as well over time, evident in the fact that despite being the closest to the centre of London, and the most urban in its amount of building coverage, it has the least number of centrality features.

5 Building Adaptability

The above analysis has shown that the continuity of generic types of activity, despite major changes to the actual functions they maintain, seems to be a consequence of there being a variety of building types, sizes and street morphologies which together are more likely to propagate patterns of co-presence over time—providing the minimal but essential balance between stability of uses, on the one hand, and adaptability in building, as well as use class, on the other. MacCormac's "reinhabited coral reefs" quoted above are essentially an observation of building scale adaptability, but this phenomenon also occurs at the urban scale. Arguably, neither a rigid structure that only allows (in the extreme case) for one use in a big box, nor a high turnover of businesses which creates an unstable system, will develop a successful centre. Taking one of the most successful cases of street morphological adaptability outlined above, we can start to explore the built form and land adaptability in a couple of streets in the area.

First, considering a section of Ewell road in Surbiton, where the highest concentration of changes of uses has taken place over the past 130 years (Figure 8), it is evident that the site predates the railway development. Space syntax analysis shows it has one of the highest degrees of "choice" in every period studied, suggesting it is likely to have benefited from high rates of through movement throughout the period. Another aspect of its adaptability over time is the building survey undertaken by Ilkka Törmä for the Adaptable Suburbs project, which shows how most of the non-domestic premises are spatially constrained—small extensions to residential buildings, both to the fronts and backs, or small buildings on small plots—but manage to adapt their premises by a variety of means. This can be seen in the axonometric projections in Figure 9, which shows the shifting patterns of subdivision into open-plan, multiple-use, rear courtyard uses and partial consolidation, forming together a classic cycle of continuity and change (Whitehand et al. 2014)[24].[4] Such streets are resilient across the scale and Törmä's (2014)[25] study showed how a shorter frontage length, smaller building footprint, smaller plot size and higher plot efficiency typically predict use change. Figure 9 shows how the section of street went through the whole gamut of division, consolidation, demolition and extension, but also—alongside a high diversity of activity—a balance between constancy and change in land uses. This illustrates how the persistence of street form is tied up with how buildings and plots are arrayed along the high street. Indeed, if we look at the pair of images in Figure 10 of the same street section in 1907 and 2015, other than the greater presence of pedestrians in the earlier period and motor vehicles in the latter, the very persistence of the general ambience of the road is the most striking aspect that one observes.

6 Conclusion

Biological analogies proliferate in architecture. Perhaps this is because of the non-discursive nature of architectural space. Yet, in this case, the notion of a high street ecology stemmed from a real life observation of the nature of historical town centres: that these seem to have a richer and more diverse mix of uses and that this diversity seems, on the one hand, to follow a spatial logic, and on the other, to be bound up with the social and economic vitality of these places. Such an ecological analogy to urban systems is effectively restating the proposition that diverse ecosystems are resilient and more able to adapt to change, as detailed in an earlier conference paper regarding this topic [26].

Bill Hillier has proposed in the past that there is "a generic process of centre formation" whereby centres start with a spatial seed, such as an intersection or indeed a single road segment which will, by virtue of its spatial configuration, have particular spatial properties that shape its future growth [27]42. This research has provided evidence to support Hillier's proposition that the subsequent growth of centres is dependent on the relative balance of the local and wider-scale ("global" scale) connections of the streets running through them which shapes their degree of interaction with neighbouring and more distant centres. We have seen evidence that the more successful of the four cases studied confirm his theory in the way in which they have evolved over the past 130 years.

The research presented here suggests that a shorter frontage length, smaller building footprint, smaller plot size and higher plot efficiency typically predict use change, but it does not necessarily follow that use change on its own is a measure of resilience, or the adaptability of the buildings to change. Whilst such streets or segments of streets can be active places—like many of the twenty cases studied across our research projects—with continuous non-domestic activity, they are not necessarily resilient in the sense that the same use has been continuous over time. Instead, they are places where uses come and go. One weakness that can be observed is that there are some plots that have become consolidated over time to allow for larger buildings to be erected, which means that in the long-term there will be less scope for diversity of uses than in the past. One conjecture that explains this process might be that the limitation in space does not allow for modification to changing needs. Whilst use change takes place at the highest rate in spatially constrained buildings, most distinctly in non-domestic buildings that are on efficiently built-up plots, the analysis also shows that small buildings situated on larger plots are more vulnerable to irreversible change. Overall, what is evident is that the overarching predictor of use change is the accessibility of the street itself as well as the flexibility of the street's area to adapt to changing scales of movement in and around it.

This research also indicates that street network complexity helps contribute to a town centre's resilience against external disruptive forces, such as economic downturns or social change (such as different populations moving into an area), although in comparison to city centres, smaller town centres are likely to be more vulnerable, given their relatively lower connectivity city-wide. In our cases this is characterised by connections via a small number of arterial roads alongside good public transport: overground trains and buses. Their lower population densities compared with urban centres means that suburban town centres somehow need to work harder to sustain themselves through economic downturns. At the same time, the long-term growth of cities towards their edges can cause a conflict between older pathways of local movement and an increase of traffic through the area [28-29]. Morphological diversity, it is argued, enables the development of niche markets in smaller centres which can support new forms of socioeconomic activity.

Notions of diversity cannot be separated from the social properties of urban and suburban built environments. Just as the fundamental intelligibility of the built environment is an essential condition of bringing people together in a public space and affording them encounter, it is a no less, possibly more, vital resource in the relatively sparse environment of the suburban town centre. Having a mix of smaller and larger buildings allows for a mix of businesses of various sizes as well as the array of activities that necessarily feed off each other within a town centre. This is why the study considered high streets within their wider context: land uses within a catchment of up to a kilometre away and built form and network connectivity within a radius of 3 km. By taking account of the larger spatial ecology, we were able to explore the full extent of the interconnected relationships between land uses and the people who serve and use them.

Evidently diversity is not the same as "mixed-use". The spatial structure of the pattern of interrela-

tionships, from building to street, from street to neighbouring street and from local streets to the wider network, works to create an interdependence of activity much wider than that observed by MacCormac. The significance of this finding is greater still if we consider that the discussion of diversity has mainly focused here on land use diversity. We might legitimately propose and use diversity as a proxy for co-presence. It is easy to overlook this self-evident aspect of land use diversity: the greater the diversity of land uses, the more likely it is to generate different sorts of activity by different sorts of people.

If we consider for a moment social diversity, folklore has it that Paris organised social classes vertically in urban courtyards, from the bourgeois on the main floor to the poor in the upper garret [30].[5] Berlin did it horizontally, with the rich at the front and the poor at the back, and London arranged classes turn-by-turn: linearly integrated, but marginally separated, as can be seen in the famous Booth map of poverty, where different street alignments each carried different poverty classes. As Hillier [31]166 has suggested, all of these are formulae for mixing uses without them getting in each other's way. In the case of London, street alignment, not the block, has tended to be the basic organising urban element. Different uses or grades of use are juxtaposed but on different streets, separated just enough to allow for the different grid conditions to play their part in generating higher amounts of movement on the main streets (where more public-facing activities can be located) and lower amounts of movement on the back streets. The process of the formation of these spatial patterns, even on the outskirts of the city, is evidently key to the continuity and robustness of London's town centres, as has been shown in this chapter.[6]

注释

Notes

1 本章中包含的部分研究内容在 2015 年 7 月举办的第十届国际空间句法研讨会上以文件的形式呈现。

Some of the research contained in this chapter was presented as a paper at the 10th International Space Syntax Symposium in July 2015.

2 有趣的是，佩恩（Penn）等人在其对克勒肯维尔土地使用模式的研究中指出了经济边缘化区域导致多样化的可能性，经济边缘化区域允许非主流人群以外专业人群营业活动区域的产生。对克勒肯维尔埃克斯茅斯市场等长期存在的市场区域的历史分析，支持了这一观点，埃克斯茅斯市场曾经是这一区域的主道，后来，在其西北部插入了一个新街面，承担有轨电车的运行，该市场街道才从一端开始分开，并逐渐退变为背景区域。

Interestingly, Penn et al.'s research on land use patterns in Clerkenwell points to the possibility that diversity could sometimes emerge as a result of economically marginal locations, allowing for places "just off" the main throng to emerge as loci of specialist businesses. Historical analysis of long- standing market places such as Exmouth Market in Clerkenwell support this contention, showing that Exmouth Market used to be the main thoroughfare of the area and it is only when a new street alignment was inserted to its northwest to carry trams that the market street came to be cut off at one end and effectively receded into the background.

3 凯利（Kelly）的目录集（1901）列出了下列内容，从瑟比顿山枢纽站往南：葡萄酒白酒商、内科外科医生、牙科医生、整形医生……内科外科医生、年轻女性基督教协会、建筑人员、装修人员、三轮车摩托车制造商、石油工人、马具商、文具商……亚麻布制品商、水果商、玉米经销商、杂货商、学校、奇珍异宝贮藏室、食品商人、化学工作者、杂货商与食品商……瑟比顿山邮局与电报局、烘焙师、屠夫、乳品加工工人、鱼贩、乳品加工工人、鞋靴仓库、杂货商与食品商、女子学校……瑟比顿城区委员会、卫斯理教堂、律师、兽医、艺术学校、咖啡馆、客栈、屠夫、昆虫经营者、天罡酒楼、五金商、制靴商、女帽制造及贩卖商、啤酒零售商、管道工、施工工人、装饰工、伞具制造商和刀剪商、三轮车摩托车公司、报刊经销商、屠夫……维多利亚酒楼、布商、煤炭商人、伦敦及省级银行有限公司、施工工人、南唐农场奶制品。

Kelly's directory (1901) lists the following, from the Surbiton Hill junction, southwards: wine & spirit merchants, physicians & surgeons, dentist, surgeon, … physicians & surgeons, Young Women's Christian Association, builder, decorator, cycle maker, oilman, saddler, stationer, … linen draper, fruiterer, corn dealers, grocer, school, fancy repository, provision merchants, chemist, grocers & provision merchants, Surbiton Hill Post & Telegraph Office, baker, butcher, dairyman, fishmonger, dairyman, boot & shoe warehouse, grocers & provision mer- chants, … girls' school, … Urban District Council of Surbiton, Wesleyan Chapel, solicitor, veterinary surgeon, School of Art, Anchor Coffee Tavern, butchers, fly proprietor, Plough Public House, ironmonger, boot maker, milliner, beer retailer, plumber, builders, upholsterer, umbrella maker & cutler, cycle company, newsagent, butcher, … Victoria Public House, draper, coal mer- chant, London & Provincial Bank Ltd., builders, South Down Farm Dairy … etc.

4 城市形态学家杰里米·怀特汉德（Jeremy Whitehand）概括了两种城市景观变化。一种是现有形式的适应性（广义而言）：包括楼宇改造工程，增加房间或改造楼顶，或街道的更改，可能会涉及车辆专用区域与行人专用区域之间关系的改变。在规划、建筑、街道或景观其他特性的整个周期内，这类变更 / 改变可能会发生在多个时间间隔期内。地理城市形态学者熟知的一个案例是土地保有权周期。在这一周期内，"土地保有权"——中世纪自治区有选举权成员通过会议产生的土地方案——逐渐形成。每种方案都促成了建筑物的建成，特别是方案形成早期，建筑形成后的几十年间，甚至几百年间，在建筑布局的沿线形成附属建筑。

另一种改变是新型建筑、街道或其他形态的引入。在英格兰，社会法则的排房在维多利亚时代和爱德华时代产生并再现，之后在一战和二战之间出现了（"通用"计划的）半独立式住房，都以"时代性"建筑，至少在那个地方被以此闻名。尽管摩天大楼和高速公路（引用美国术语）的引入时期和位置不同，但引入范围极广，特别是在 20 世纪。

The urban morphologist Jeremy Whitehand outlines two kinds of urban landscape change. One is the adaptation (in a broad sense) of existing forms: this includes, for example, the modification of a building, perhaps by adding rooms or changing the roof, or, in the case of a street, it might involve changing the relationship between the areas allocated to vehicles and those for pedestrian use only. Changes of this type may occur at various intervals over the lifespan of a plot, building, street, or other feature in the landscape. An example well known among geographical urban morphologists is the burgage cycle. In this cycle the "burgages"—the plots of land derived from those held by the enfranchised members of medieval boroughs—become progressively built up. Each plot has a building constructed at its head, usually early in the life of the plot, and this is followed by subsidiary buildings being added along the length of the plot over many decades, or sometimes over centuries …

The other kind of change is the introduction of new types of buildings, streets or other features. In England, bye-law terraced houses introduced and reproduced in the Victorian and Edwardian periods, followed by semi-detached houses (of "universal" plan) in the interwar period, are well-known "period types", at least in that part of the world. The tower block and the expressway (to use the American term) were widespread introductions, essentially in the twentieth century, although introduced in different parts of the world at different times.

5 安德里亚斯·伯纳德（Andreas Bernard）认为，尽管 19 世纪时期，楼宇的阁楼和地下室带来诸多不便，但到 20 世纪早期，电梯的发明"解脱了'酒店'上层部分产生的尴尬并带来了某种魅力"，这意味着顶层房间可以收取最高费用的租金。

Andreas Bernard (2014) argues that whilst in the nineteenth century the attic and basements of buildings attracted a stigma of abnormality, by the early twentieth century, the invention of the lift in fact "freed the upper storeys of hotels from the stigma of inaccessibility and lent them an unheard-of glamour", meaning that the highest rental prices could be charged for penthouses.

6 确实，聚集与分离可以并存，见移民聚居模式的历史研究 [32]493, 495。

Indeed, both clustering and separation can co-exist, as shown in historical research into immigrant settlement patterns [32]493, 495.

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